We claim:

1. A cell comprising alanine 2,3-aminomutase activity, wherein the cell produces beta-alanine from alpha-alanine.

2. The cell of claim 1, wherein the cell is a transformed cell.

3. The cell of claim 2, wherein the cell comprises at least one exogenous nucleic acid molecule, wherein the nucleic acid molecule comprises a nucleic acid sequence that encodes an alanine 2,3-aminomutase.

4. The cell of claim 3, wherein the exogenous nucleic acid molecule is a mutated lysine 2,3-aminomutase.

5. The cell of claim 3, wherein the exogenous nucleic acid molecule is a mutated leucine 2,3-aminomutase.

6. The cell of claim 3, wherein the exogenous nucleic acid molecule is a mutated lysine 5,6-aminomutase.

7. The cell of claim 3, wherein the nucleic acid sequence that encodes an alanine 2,3-aminomutase comprises nucleotides 307-1017 of a sequence shown in SEQ ID NO: 20 or nucleotides 55-1026 of a sequence shown in SEQ ID NO: 29.

8. The cell of claim 7, wherein the nucleic acid comprising nucleotides 307-1017 of SEQ ID NO: 20 or nucleotides 55-1026 of SEQ ID NO: 29 includes one or more substitutions that result in one or more conservative amino acid substitutions.

9. The cell of claim 7, wherein the nucleic acid comprising nucleotides 307-1017 of SEQ ID NO: 20 or nucleotides 55-1026 of a sequence shown in SEQ ID NO: 29 includes one or more substitutions that result in no more than 10 conservative amino acid substitutions.

10. The cell of claim 3, wherein the nucleic acid sequence that encodes an alanine 2,3-aminomutase comprises a sequence having at least 90% identity to SEQ ID NO: 20 or SEQ ID NO: 29.

11. The cell of claim 10, wherein the nucleic acid sequence that encodes an alanine 2,3-aminomutase comprises a sequence having at least 95% identity to SEQ ID NO: 20 or SEQ ID NO: 29.

12. The cell of claim 10, wherein the nucleic acid sequence that encodes an alanine 2,3-aminomutase comprises SEQ ID NO: 20 or SEQ ID NO: 29.

13. The cell of claim 4, wherein the mutated lysine 2,3-aminomutase is a mutated prokaryotic lysine 2,3-aminomutase.

14. The cell of claim 13, wherein the mutated prokaryotic lysine 2,3-aminomutase is a mutated *Bacillus subtilis*, *Deinococcus radiodurans*, *Clostridium subterminale*, *Porphyromonas gingivalis*, or *Escherichia coli* lysine 2,3-aminomutase.

15. The cell of claim 14, wherein the mutated lysine 2,3-aminomutase is a mutated *B. subtilis* lysine 2,3-aminomutase.

16. The cell of claim 15, wherein the mutated *B. subtilis* lysine 2,3-aminomutase comprises an L103M, L103K, L103R, L103E, or L103S substitution.

17. The cell of claim 15, wherein the mutated *B. subtilis* lysine 2,3-aminomutase comprises a L103M, a M136V substitution, a D339H substitution, or any combination thereof.

18. The cell of claim 15, wherein the mutated *B. subtilis* lysine 2,3-aminomutase comprises an D339H, D339Q, D339T, or D339N substitution.

19. The cell of claim 14, wherein the mutated lysine 2,3-aminomutase is a mutated *P. gingivalis* lysine 2,3-aminomutase.

20. The cell of claim 19, wherein the mutated *P. gingivalis* lysine 2,3-aminomutase comprises an N19Y substitution, an L53P substitution, an H85Q substitution, a D331G substitution, a M342T substitution, or any combination thereof.

21. The cell of claim 6, wherein the mutated lysine 5,6-aminomutase is a mutated *C. sticklandii* lysine 5,6-aminomutase.

22. The cell of claim 1, wherein the cell is prokaryotic.

23. The cell of claim 22, wherein the prokaryotic cell is a *Lactobacillus*, *Lactococcus*, *Bacillus*, or *Escherichia* cell.

24. The cell of claim 22, wherein the prokaryotic cell is an *Escherichia coli* or *Bacillus licheniformis* cell.

25. The cell of claim 1, wherein the cell is a yeast cell.

26. The cell of claim 1, wherein the cell produces 3-hydropropionic acid (3-HP).

27. The cell of claim 26, wherein the cell further comprises:
CoA transferase or CoA synthetase activity;
beta-alanyl-CoA ammonia lyase activity; and
3HP-CoA dehydratase activity.

28. The cell of claim 27, wherein the cell further comprises 3-hydroxypropionyl-CoA hydrolase, and/or 3-hydroxyisobutryl-CoA hydrolase activity.

29. The cell of claim 26, wherein the cell further comprises
4-aminobutyrate and/or beta-alanine – 2-oxoglutarate aminotransferase activity; and
3-HP dehydrogenase activity or 3-hydroxyisobutyrate dehydrogenase activity.

30. The cell of claim 1, wherein the cell further comprises:
CoA transferase or CoA synthetase activity;
beta-alanyl-CoA ammonia lyase activity;
3-hydroxypropionyl-CoA dehydratase activity;
3-hydroxypropionyl-CoA hydrolase, and/or 3-hydroxyisobutryl-CoA hydrolase activity; and
lipase and/or esterase activity.

31. The cell of claim 30, wherein the cell produces an ester of 3-HP.

32. The cell of claim 31, wherein the ester of 3-HP is methyl 3-hydroxypropionate, ethyl 3-hydroxypropionate, propyl 3-hydroxypropionate, butyl 3-hydroxypropionate, or 2-ethylhexyl 3-hydroxypropionate.

33. The cell of claim 1, wherein the cell further comprises:
CoA transferase activity;
beta-alanyl-CoA ammonia lyase activity;

3-hydroxypropionyl-CoA dehydratase activity; and
poly hydroxacid synthase activity.

34. The cell of claim 33, wherein the cell produces polymerized 3-HP.

35. The cell of claim 1, wherein the cell further comprises:
CoA transferase activity;
beta-alanyl-CoA ammonia lyase activity; and
poly hydroxacid synthase activity.

36. The cell of claim 35, wherein the cell produces polymerized acrylate.

37. The cell of claim 1, wherein the cell further comprises
CoA transferase activity;
beta-alanyl-CoA ammonia lyase activity; and
lipase and/or esterase activity.

38. The cell of claim 37, wherein the cell produces an ester of acrylate.

39. The cell of claim 38, wherein the ester of acrylate is methyl acrylate, ethyl acrylate, propyl acrylate, or butyl acrylate.

40. The cell of claim 1, wherein the cell produces 1,3-propanediol.

41. The cell of claim 40, wherein the cell further comprises:
CoA transferase or CoA synthetase activity;
beta-alanyl-CoA ammonia lyase activity;
3-hydroxypropionyl-CoA dehydratase activity;
acetylating aldehyde:NAD(+) oxidoreductase activity; and
alcohol:NAD(+) oxidoreductase activity.

42. The cell of claim 40, wherein the cell further comprises:
CoA transferase activity;
beta-alanyl-CoA ammonia lyase activity;
3-hydroxypropionyl-CoA dehydratase activity;
3-hydroxypropionyl-CoA hydrolase, and/or 3-hydroxyisobutryl-CoA hydrolase activity;
aldehyde dehydrogenase (NAD(P)+) activity; and
alcohol dehydrogenase activity.

43. The cell of claim 1, wherein the cell produces pantothenate.

44. The cell of claim 43, further comprising alpha-ketopantoate hydroxymethyltransferase, alpha-ketopantoate reductase, and pantothenate synthase activity.

45. The cell of claim 43, wherein the cell produces coenzyme A (CoA).

46. The cell of claim 45, further comprising pantothenate kinase, 4'-phosphopantethenoyl-1-cysteine synthetase, 4'-phosphopantothenoylcysteine decarboxylase, ATP:4'-phosphopantetheine adenyltransferase, and dephospho-CoA kinase activity.

47. A polypeptide comprising alanine 2,3-aminomutase activity.

48. The polypeptide of claim 47, wherein the polypeptide comprises a mutated lysine 2,3-aminomutase amino acid sequence.

49. The polypeptide of claim 48, wherein the mutated lysine 2,3-aminomutase amino acid sequence is a mutated *Bacillus subtilis*, *Deinococcus radiodurans*, *Clostridium subterminale*, *Porphyromonas gingivalis* or *Escherichia coli* lysine 2,3-aminomutase.

50. The polypeptide of claim 49, wherein the mutated lysine 2,3-aminomutase amino acid sequence is a mutated *Bacillus subtilis or* mutated *Porphyromonas gingivalis* lysine 2,3-aminomutase.

51. The polypeptide of claim 47, wherein the polypeptide comprises amino acids 50-390 of a sequence shown in SEQ ID NO: 21 or amino acids 15-390 of a sequence shown in SEQ ID NO: 30.

52. The polypeptide of claim 47, wherein the polypeptide comprises a sequence having at least 90% sequence identity to SEQ ID NO: 21 or 30.

53. The polypeptide of claim 52, wherein the polypeptide comprises a sequence having at least 95% sequence identity to SEQ ID NO: 21 or 30.

54. The polypeptide of claim 52, wherein the polypeptide comprises SEQ ID NO: 21 or 30.

55. The polypeptide of claim 52, wherein the polypeptide comprises one or more conservative amino acid substitutions.

56. The polypeptide of claim 52, wherein the polypeptide comprises no more than 10 conservative amino acid substitutions.

57. An isolated nucleic acid comprising a nucleic acid sequence that encodes the polypeptide of claim 47.

58. The isolated nucleic acid of claim 57 operably linked to a promoter sequence.

59. The isolated nucleic acid of claim 57, wherein the nucleic acid comprises nucleotides 307-1017 of SEQ ID NO: 20 or nucleotides 55-1026 of SEQ ID NO: 29.

60. The isolated nucleic acid of claim 57,wherein the nucleic acid comprises a sequence having at least 90% identity to SEQ ID NO: 20 or SEQ ID NO: 29.

61. The isolated nucleic acid of claim 57,wherein the nucleic acid comprises a sequence having at least 95% identity to SEQ ID NO: 20 or SEQ ID NO: 29.

62. The isolated nucleic acid of claim 60, wherein the nucleic acid sequence includes one or more substitutions which results in one or more conservative amino acid substitutions.

63. The isolated nucleic acid of claim 60, wherein the nucleic acid sequence includes one or more substitutions which results in no more than 10 conservative amino acid substitutions.

64. The isolated nucleic acid of claim 61, wherein the nucleic acid comprises SEQ ID NO: 20 or 29.

65. A vector comprising the isolated nucleic acid of claim 57.

66. A recombinant nucleic acid comprising the isolated nucleic acid of claim 57.

67. A cell transformed with the recombinant nucleic acid of claim 66.

68. A non-human transgenic mammal comprising the recombinant nucleic acid of claim 57.

69. A transformed cell comprising at least one exogenous nucleic acid molecule, wherein the at least one exogenous nucleic acid molecule comprises a nucleic acid sequence that encodes the polypeptide of claim 47.

70. The transformed cell of claim 69, wherein the cell produces beta-alanine from alpha-alanine.

71. The cell of claim 70, wherein the cell produces 3-HP.

72. The cell of claim 71, wherein the cell produces 1,3-propanediol.

73. The cell of claim 70, wherein the cell produces pantothenate.

74. The cell of claim 73, wherein the cell produces CoA.

75. A specific binding agent that specifically binds to the polypeptide of claim 47.

76. A method of producing a polypeptide comprising alanine 2,3-aminomutase activity, comprising culturing the cell of claim 67 under conditions that allow the cell to produce the polypeptide comprising alanine 2,3-aminomutase activity.

77. A method for making beta-alanine from alpha-alanine, comprising culturing the cell of claim 1 under conditions that allow the cell to make beta-alanine from alpha-alanine.

78. The method of claim 77, wherein the cell comprises at least one exogenous nucleic acid molecule that encodes an alanine 2,3-aminomutase, wherein the alanine 2,3-aminomutase is capable of producing the beta-alanine from the alpha-alanine.

79. The method of claim 78, wherein the cell is a prokaryotic cell.

80. The method of claim 78, wherein the cell is a yeast, *Lactobacillus*, *Lactococcus*, *Bacillus*, or *Escherichia* cell.

81. The method of claim 78, wherein the cell comprises a functional deletion of *panD*.

82. A method of identifying a cell comprising alanine 2,3-aminomutase activity, comprising:

culturing a cell functionally deleted for *panD* in media comprising no beta-alanine and no pantothenate; and

identifying a cell which is capable of growing in the media, wherein growth of the cell indicates that the cell is producing beta-alanine from alpha-alanine, which indicates the cell comprises alanine 2,3-aminomutase activity, and wherein absence of growth of the cell indicates that the cell is not producing beta-alanine from alpha-alanine, which indicates the cell does not comprise alanine 2,3-aminomutase activity.

83. The method of claim 82, further comprising transfecting the cell with one or more mutated lysine 2,3-aminomutases, prior to the step of culturing the cell.

84. The method of claim 83, wherein the one or more mutated prokaryotic lysine 2,3-aminomutase is a mutated *Bacillus subtilis*, *Deinococcus radiodurans*, *Clostridium subterminale*, *Aquifex aeolicus*, *Haemophilus influenza*, *Escherichia coli* and/or *Porphyromonas gingivalis* lysine 2,3-aminomutase.

85. The method of claim 83, wherein the one or more mutated lysine 2,3-aminomutases is a mutated *B. subtilis* lysine 2,3-aminomutase.

86. The method of claim 83, further comprising identifying a mutation in the one or more mutated lysine 2,3-aminomutases which confer the alanine 2,3-aminomutase activity to the cell, following identifying a cell which grows in the media.

87. The method of claim 86, wherein identifying the mutation in the one or more mutated lysine 2,3-aminomutases comprises sequencing the one or more mutated lysine 2,3-aminomutases.

88. The method of claim 82, wherein the cell is a prokaryotic cell.

89. A method for making 3-HP, comprising culturing the cell of claim 1 under conditions wherein the cell produces the 3-HP.

90. The method of claim 89, wherein the cell comprises at least one exogenous nucleic acid that encodes an alanine 2,3-aminomutase such that the 3-HP is produced from beta-alanine, wherein the alanine 2,3-aminomutase produces beta-alanine from alpha-alanine.

91. The method of claim 89, wherein the cell further comprises:
CoA transferase or CoA synthetase activity;
beta-alanyl-CoA ammonia lyase activity;
3-HP-CoA dehydratase activity; and
3-hydroxypropionyl-CoA hydrolase, and/or 3-hydroxyisobutryl-CoA hydrolase activity

92. The method of claim 89, wherein the cell further comprises:
4-aminobutyrate and/or beta alanine-2-oxoglutarate aminotransferase activity; and
3-HP dehydrogenase and/or 3-hydroxybutyrate dehydrogenase activity.

93. A method for making 1,3-propanediol, comprising culturing the cell of claim 40 under conditions wherein the cell produces the 1,3-propanediol.

94. A method for making pantothenate, comprising culturing the cell of claim 43 under conditions wherein the cell produces the pantothenate.

95. A method for making CoA comprising culturing the cell of claim 45 under conditions wherein the cell produces the CoA.

96. A method for making 3-HP, comprising:

purifying beta-alanine from the cell of claim 1;

contacting the beta-alanine with a polypeptide comprising CoA transferase activity to form beta-alanyl-CoA;

contacting the beta-alanine CoA with a polypeptide comprising beta-alanyl-CoA ammonia lyase activity to form acrylyl-CoA;

contacting the acrylyl-CoA with a polypeptide comprising 3HP-CoA dehydratase activity to form 3-HP-CoA; and

contacting 3-HP-CoA with a polypeptide comprising CoA transferase activity, 3-hydroxypropionyl-CoA hydrolase, and/or 3-hydroxyisobutryl-CoA hydrolase activity to make 3-HP.

97. A method for making 3-HP, comprising:

purifying beta-alanine from the cell of claim 1;

contacting the beta-alanine with a polypeptide comprising 4-aminobutyrate aminotransferase and/or beta-alanine – 2-oxoglutarate aminotransferase activity to form malonic semialdehyde; and

contacting the malonic semialdehyde with a polypeptide comprising 3-HP dehydrogenase and/or 3-hydroxyisobutyrate dehydrogenase activity to make 3-HP.

98. A method for making 3-HP, comprising:

transfecting the cell of claim 1, with a nucleic acid encoding a polypeptide comprising CoA transferase activity, with a nucleic acid encoding a polypeptide comprising beta-alanyl-CoA ammonia lyase activity, and with a nucleic acid encoding a polypeptide comprising CoA transferase activity, 3-hydroxypropionyl-CoA hydrolase, and/or 3-hydroxyisobutryl-CoA hydrolase activity; and

culturing the transfected cell to allow the transfected cell to make 3-HP.

99. A method for making 3-HP, comprising:

transfecting the cell of claim 1, with a nucleic acid encoding a polypeptide comprising 4-aminobutyrate aminotransferase and/or beta-alanine-2-oxoglutarate aminotransferase activity and with a nucleic acid encoding a polypeptide comprising 3-HP dehydrogenase and/or 3-

hydroxyisobutyrate dehydrogenase activity; and

culturing the transfected cell to allow the transfected cell to make 3-HP.

100. A method for making 1,3-propanediol from 3-HP, comprising:

making 3-HP using the method of claim 97;

contacting the 3-HP with a polypeptide comprising acetylating aldehyde:NAD(+) oxidoreductase activity and a polypeptide comprising alcohol:NAD(+) oxidoreductase activity.

101. A method for making 1,3-propanediol, comprising:

transfecting the cell of claim 1 with a nucleic acid encoding a polypeptide comprising CoA transferase or CoA synthetase activity; with a nucleic acid encoding a polypeptide comprising beta-alanyl-CoA ammonia lyase activity; a nucleic acid encoding a polypeptide comprising, 3-hydroxypropionyl-CoA hydrolase, and/or 3-hydroxyisobutryl-CoA hydrolase activity; a nucleic acid encoding a polypeptide comprising acetylating aldehyde:NAD(+) oxidoreductase activity; and a nucleic acid encoding a polypeptide comprising alcohol:NAD(+) oxidoreductase activity; and

culturing the transfected cell to allow the transfected cell to make 1,3-propanediol.

102. A method for making 1,3-propanediol, comprising:

transfecting the cell of claim 1 with a nucleic acid encoding a polypeptide comprising CoA transferase or CoA synthetase activity; with a nucleic acid encoding a polypeptide comprising beta-alanyl-CoA ammonia lyase activity; with a nucleic acid encoding a polypeptide comprising 3-hydroxypropionyl-CoA dehydratase activity; with a nucleic acid encoding a polypeptide comprising 3-hydroxypropionyl-CoA hydrolase, and/or 3-hydroxyisobutryl-CoA hydrolase activity; with a nucleic acid encoding a polypeptide comprising aldehyde dehydrogenase (NAD(P)+) activity; with a nucleic acid encoding a polypeptide comprising alcohol dehydrogenase activity and

culturing the transfected cell to allow the transfected cell to make 1,3-propanediol.

103. A method for making pantothenate, comprising:

purifying beta-alanine from the cell of claim 1; and

contacting the beta-alanine with alpha-ketopantoate hydroxymethyltransferase, alpha-ketopantoate reductase, and pantothenate synthase to make pantothenate.

104. A method for making pantothenate, comprising:

transfecting the cell of claim 1 with a nucleic acid encoding a polypeptide comprising alpha-ketopantoate hydroxymethyltransferase activity, a nucleic acid encoding a polypeptide comprising alpha-ketopantoate reductase activity, and a nucleic acid encoding a polypeptide comprising pantothenate synthase activity; and

culturing the transfected cell to allow the transfected cell to make pantothenate.

105. The cell of claim 1, wherein the cell is a plant cell.

106. A plant comprising the cell of claim 104.

106. A transgenic plant comprising the recombinant nucleic acid of claim 57.